WHAT IS CLAIMED IS:

1. A method for controlling a DC-DC converter, wherein the DC-DC converter includes a first capacitor, a second capacitor, a diode connected in series with the first capacitor, and a main switching transistor having a source, a gate, and a drain, the method comprising:

connecting the diode and the first capacitor that are connected in series with each other between the source and the drain of the main switching transistor;

activating and inactivating the main switching transistor;

generating gate voltage to drive the main switching transistor by connecting the second capacitor in parallel to the first capacitor or by disconnecting the second capacitor from the first capacitor in synchronism with the activation and inactivation of the main switching transistor; and

switching the main switching transistor with the gate voltage.

2. The method according to claim 1, wherein the DC-DC converter further includes a driver circuit for driving the main switching transistor, the method further comprising:

disconnecting the first capacitor and the second capacitor when the main switching transistor is inactivated to charge the first capacitor via the diode with input voltage supplied to the main switching transistor;

connecting the first capacitor and the second capacitor in parallel to each other when the main switching transistor is activated to charge the second capacitor with the first capacitor; and

supplying the voltage of the charged second capacitor to the driver circuit as drive voltage of the driver

circuit.

3. The method according to claim 1, further comprising:

monitoring the voltage of the second capacitor; and

controlling the connection and disconnection of the first capacitor and the second capacitor in accordance with the monitored voltage of the second capacitor.

4. The method according to claim 1, wherein the DC-DC converter includes a synchronous rectification transistor connected in series to the main switching transistor, the method further comprising:

inactivating the synchronous rectification transistor when the main switching transistor is activated, and activating the synchronous rectification transistor when the main switching transistor is inactivated.

5. The method according to claim 1, wherein:

each of the first and second capacitors includes a first terminal and a second terminal;

the first terminal of the first capacitor is connected to the diode, the second terminal of the first capacitor is connected to the second terminal of the second capacitor; and

said generating gate voltage includes connecting and disconnecting the first terminal of the first capacitor and the first terminal of the second capacitor.

6. A DC-DC converter comprising:

a main switching transistor having a source, a gate, and a drain; and

a gate voltage generation circuit connected to the main

switching transistor to generate gate voltage for driving the main switching transistor, the gate voltage generation circuit including:

a series-connected circuit configured by a diode and a first capacitor connected between the source and the drain of the main switching transistor;

a switch circuit connected to the first capacitor; and

a second capacitor connected in parallel to the first capacitor via the switch circuit, wherein the gate voltage generation circuit generates the gate voltage by connecting or disconnecting the first and second capacitors in synchronism with activation and inactivation of the main switching transistor.

7. The DC-DC converter according to claim 6, further comprising:

a drive circuit connected to the main switching transistor, the second capacitor, and the switch circuit to drive the main switching transistor, wherein:

the first capacitor is charged via the diode with input voltage supplied to the main switching transistor when the main switching transistor is inactivated; and

the second capacitor connected in parallel to the first capacitor by the switch circuit is charged by the first capacitor when the main switching transistor is activated to generate charged voltage that is supplied to the drive circuit as drive voltage.

8. The DC-DC converter according to claim 7, wherein the gate voltage generation circuit further includes:

a voltage monitoring circuit connected to the second capacitor for monitoring the voltage of the second capacitor

to generate a monitoring signal; and

a switch control circuit connected to the voltage monitoring circuit and the switch circuit to activate and inactivate the switch circuit in accordance with the monitoring signal.

9. The DC-DC converter according to claim 7, further comprising:

a synchronous rectification transistor connected in series to the main switching transistor and switched with the main switching transistor in a complementary manner.

10. A DC-DC converter for converting an input voltage to a desired voltage, the DC-DC converter comprising:

a main switching transistor having a source, a gate, and a drain;

a first capacitor and a second capacitor connected between the source and the drain of the main switching transistor to divide the input voltage; and

a drive voltage generation circuit for generating drive voltage for the main switching transistor with the input voltage divided by the first capacitor and the second capacitor.

11. A DC-DC converter for converting an input voltage to a desired voltage, the DC-DC converter comprising:

a main switching transistor having a source, a gate, and a drain;

a first capacitor connected between the source and the drain of the main switching transistor to generate first charged voltage with the input voltage;

a second capacitor selectively connected to the first capacitor and charged by the first charged voltage to

generate second charged voltage; and

a drive voltage generation circuit for generating drive voltage for the main switching transistor with the second charged voltage.

12. The DC-DC converter according to claim 11, wherein the drive voltage generation circuit includes:

a switch circuit connected between the first capacitor and the second capacitor, the switch circuit selectively connecting the second capacitor to the first capacitor in synchronism with activation and inactivation of the main switching transistor.

13. The DC-DC converter according to claim 12, wherein the drive voltage generation circuit further includes:

a voltage monitoring circuit for monitoring the second charged voltage to generate a monitoring signal; and

a switch control circuit connected to the voltage monitoring circuit and the switch circuit to activate and inactivate the switch circuit in accordance with the monitoring signal.

14. The DC-DC converter according to claim 11, further comprising:

a synchronous rectification transistor connected in series to the main switching transistor and switched with the main switching transistor in a complementary manner.

15. A semiconductor device for a DC-DC converter, wherein the DC-DC converter includes:

a main switching transistor having a source, a gate, and a drain;

a series-connected circuit configured by a diode and a

first capacitor connected between the source and the drain of the main switching circuit; and

a second capacitor connected to the first capacitor, the semiconductor device comprising:

a switch circuit connected between the first capacitor and the second capacitor, the switch circuit connecting or disconnecting the first and second capacitors in synchronism with activation and inactivation of the main switching transistor to generate gate voltage for the main switching transistor; and

a drive signal generation circuit connected to the switch circuit to generate a drive signal of the main switching transistor.

16. The semiconductor device according to claim 15, wherein the drive signal generation circuit includes:

a voltage dividing resistor for dividing output voltage of the DC-DC converter to generate divisional voltage;

an error amplifier connected to the voltage dividing resistor to amplify the difference between the divisional voltage and a reference voltage to generate an error amplification signal;

a triangular wave oscillator for generating a triangular wave signal; and

a PWM comparator connected to the error amplifier and the triangular wave oscillator to compare the triangular wave signal with the error amplification signal and generate a PWM signal as the drive signal.

17. The semiconductor device according to claim 15, further comprising:

a drive circuit connected to the main switching transistor, the second capacitor, and the switch circuit to

drive the main switching transistor, wherein the drive circuit receives the gate voltage from the second capacitor as drive voltage of the drive circuit;

a voltage monitoring circuit connected to the second capacitor to monitor the voltage of the second capacitor and generate a monitoring signal; and

a switch control circuit connected to the voltage monitoring circuit and the switch circuit to activate and inactivate the switch circuit in accordance with the monitoring signal.

18. A semiconductor device for a DC-DC converter, wherein the DC-DC converter includes:

a series-connected circuit configured by a diode and a first capacitor; and

a second capacitor connected to the first capacitor, the semiconductor device comprising:

a main switching transistor connected to the first capacitor and the second capacitor and having a source, a gate, and a drain, wherein the series-connected circuit is connected between the source and the drain of the main switching transistor; and

a switch circuit connected between the first capacitor and the second capacitor, the switch circuit connecting or disconnecting the first and second capacitors in synchronism with activation and inactivation of the main switching transistor to generate gate voltage for the main switching transistor.

19. The semiconductor device according to claim 18, further comprising:

a drive circuit connected to the main switching transistor, the second capacitor, and the switch circuit to

drive the main switching transistor, wherein the drive circuit receives the gate voltage from the second capacitor as drive voltage of the drive circuit;

a voltage monitoring circuit connected to the second capacitor to monitor the voltage of the second capacitor and generate a monitoring signal; and

a switch control circuit connected to the voltage monitoring circuit and the switch circuit to activate and inactivate the switch circuit in accordance with the monitoring signal.

20. The DC-DC converter according to claim 18, further comprising:

a synchronous rectification transistor connected in series to the main switching transistor and switched with the main switching transistor in a complementary manner.

21. An electronic device comprising:

a DC-DC converter including:

a main switching transistor having a source, a gate, and a drain; and

a gate voltage generation circuit connected to the main switching transistor to generate gate voltage for driving the main switching transistor, the gate voltage generation circuit including:

a series-connected circuit configured by a diode and a first capacitor connected between the source and the drain of the main switching transistor;

a switch circuit connected to the first capacitor; and

a second capacitor connected in parallel to the first capacitor via the switch circuit, wherein the gate voltage generation circuit generates the gate

voltage by connecting or disconnecting the first and second capacitors in synchronism with activation and inactivation of the main switching transistor.

22. The electronic device according to claim 21, wherein the DC-DC converter further includes:

a synchronous rectification transistor connected in series to the main switching transistor and switched with the main switching transistor in a complementary manner.